

Consumers' preferences and composition of Livanjski cheese in relation to its sensory characteristics

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Abstract

The aim of this study was to investigate consumers' preferences of Livanjski cheese depending on the type of milk (cow's milk or a mixture of sheep's and cow's milk) and the originality of production (farm or industrially produced). Also correlations between sensorial scores and the composition of Livanjski cheese were determined. Sixty day old Livanjski cheese samples produced on four family farms and under industrial conditions produced cheese were used for sensory evaluation. During the cheese sampling every producer was visited regularly (every two weeks) to evaluate the ripening conditions of the cheeses (temperature, relative air humidity and ventilation). Sensory evaluation was performed by 160 consumers and 6 experts. Cheese from farm 1 received the highest scores ($P < 0.05$) in general and for every single attribute as well. The production of Livanjski cheese on farm 1 was distinct due to mixing sheep's and cow's milk (70:30 %) and due to good controlled ripening conditions (15-18 °C, relative air humidity 80-90 %, regular air ventilation). Sheep's milk was an important factor for the higher scoring of Livanjski cheese. In opposite to the consumers' preference, experts evaluated industrially produced Livanjski cheese with the highest score. Significantly high and negative correlations ($P < 0.05$) between total solids of cheese and scores for taste and odour judged by experts were obtained. Moreover, significantly higher and negative correlations ($P < 0.05$) between the total solids of cheese and all sensorial attributes were obtained by consumers. On the contrary, preserving factors i.e. higher salt content and acidity positively influenced the sensory attributes of Livanjski cheese.

Key words: sheep's milk, cow's milk, Livanjski cheese, consumers' preferences,
sensory quality, composition

Introduction

Livanjski cheese belongs to the group of the most popular autochthonous cheese in Bosnia and Herzegovina. The cheese has medium sized eyes regularly distributed on the cut surface, has a yel-

lowish coloured body, well cared yellowish rind, pleasant odour, with medium salt content and well expressed taste typical for cheep's cheese. Texture of Livanjski cheese is hard but elastic (Filjak and Dozet, 1953; Dozet et al., 1996; Kutle, 1996; Kirin et al., 2003; Sarić, 2002). It belongs to the

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group of full fat cheeses. Industrially produced Livanjski cheese is manufactured only from pasteurized cow's milk with the usage of a starter culture. In contrast to that, small family farms produce Livanjski cheese from raw cow's or mixed cow and sheep's milk without applying starter cultures. Sensory characteristics of the cheese vary, depending on the type of milk used for cheese production, as well as on the milk heat treatment, which directly influences biochemical changes during cheese ripening. Therefore, cheese produced from raw milk ripened faster and developed a more intense flavour in comparison to cheese of the same age produced from pasteurized milk (Lau et al., 1991). Similar results were obtained by Sarić et al. (2010), who found that Livanjski cheese produced from raw milk had a more intense flavour, but less elastic body and less eyes on the cut surface in comparison to industrially produced Livanjski cheese.

The production of Livanjski cheese began in 1886, when this cheese was produced exclusively from sheep's milk. Later, due to the lack of sheep's milk, the production of Livanjski cheese partly or totally switched to cow's milk. Some farmers and industries use only cow's milk, but many local farmers still use a mixture of sheep's and cow's milk in its production. Sarić et al., (2010) studied consumer's preference towards Livanjski cheese produced from raw or pasteurized milk. They concluded that consumer's preferred industrial Livanjski cheese produced from pasteurized milk versus Livanjski cheese produced on the farm. But they surveyed consumers from central Bosnia, not local consumers. However, it is desirable for the studying of preferences of traditional local cheese to survey local consumers, taking into consideration that they could easily recognise the authenticity of some of the local cheese varieties (Valkaj et al., 2013). According to Franjić (1983) the best Livanjski cheese was produced from a mixture of sheep's and cow's milk using a ratio of 80:20, but no investigations were conducted on consumers' preference to confirm this sentiment. Therefore, the aim of this study was to investigate consumer preferences of Livanjski cheese depending on the milk type (cow's milk or a mixture of sheep's and cow's milk) and the originality of production (farm produced or industrially produced). Furthermore, also correlations between sensorial scores and the composition of the Livanjski cheese were determined.

Materials and methods

Scoring of sensory characteristics

Sixty day old Livanjski cheese was used for the scoring of sensory characteristics. Two loaves of cheese (about 2.5 kg weights per cylinder) were taken from each producer (four from farms and one industrial). Two farms (F1 and F2) produced Livanjski cheese from mixed sheep's and cow's milk (70:30 and 50:50 %); while others produced Livanjski cheese only from cow's milk (including the industrial produced Livanjski cheese). Industrial Livanjski cheese was made from pasteurised milk but the farm produced Livanjski cheese was not. The labels of the cheese samples were removed from each cheese and every sample randomly received a determined number (1-10). During cheese sampling every producer was visited regularly (every two weeks) to evaluate the ripening condition of the cheeses (temperature, relative air humidity and ventilation).

For sensory evaluation 160 consumers and 6 experts were involved in the scoring. Every consumer included in the investigation received a questioner which consisted of following questions: *Do you consider yourself familiar with Livanjski cheese?; Where do you purchase Livanjski cheese?; Does Livanjski cheese contain some specificity in comparison to similar cheeses?; How often and from where do you purchase Livanjski cheese?; How often do you consume Livanjski cheese?;* gender and age of the consumer, as well as the residence place. Consumers were also requested to define the most important attributes of Livanjski cheese, i.e. taste, odour, colour and specificity of the production. Sensory evaluation done by the experts included appearance, colour, texture, cut surface, odour and taste, while consumers evaluated the taste, odour, piquancy, bitterness and intensity of salt. Every single attribute could be scored by 1 to 5 points according to the Likert's scale, where 5 points represented the best cheese while 1 point represented the worst characteristic (Radman et al., 2004). Therefore, every consumer could allocate up to 20 points for four attributes for each sample. For every attribute consumers could give up to five points. Therefore, the total score that consumers could give for each sample was 20 points. The sensory evaluation of the expert scoring system described by Mioč et al. (2000) and Sarić et al. (2002) was conducted. The maximal score for appearance was

2 points, for colour 1 point, for texture 2 points, for cut surface 3 points, for odour 2 points and for taste 10 points. Therefore the maximum score could be 20 points. Consumers were chosen randomly and each of them received a questioner. They were instructed how to fill in the questioner. Consumers' preferences were conducted in Livno (central place for production and consumption of Livanjski cheese) during the manifestation of the promotion and exhibition of Livanjski cheese.

Composition of Livanjski cheese

Total solids of cheese were determined by drying at 103 ± 2 °C for four hours according to HRN ISO 5534-2008 method. Fat content of the cheese was determined according to the Van Gulik method (HRN ISO 3433-2009). Protein content of the cheese was determined according to the Kjeldahl method (HRN ISO 8968-2:2003) using Kjeltac 2300 (Foss, Denmark). Salt content of the cheese was determined according to the Volhard method (AOAC 935.43:2000). Lactic acid concentration was determined by the titratable method (Lau et al., 1991) and pH value using the, Seven Multi (Mettler Toledo, Switzerland), according to manufacturer's instructions.

Statistical analysis

All data were analysed using statistical software SAS (version 8.2, 2000). Descriptive statistics were used to analyse respondents' questionnaire and their preferences and frequencies to purchasing and consumption of Livanjski cheese were calculated (PROC FREQ). The analysis of variance (PROC GLM) was used to test the effect of producers (type of production) on chemical composition and sensory scoring of cheese. The Pearson correlation coefficients (PROC CORR) were used to determine the relationship between the chemical composition and the sensory properties of cheese.

Results and discussion

Experts' scoring, respondents' questionnaire and their preferences of Livanjski cheese

A face-to face consumer questionnaire was performed on September 2011 engaging 160 visitors during the exhibition entitled "*Days of Livanjski*

cheese". Among the visitors 57 % were male, 43 % were female, and the average age of the visitors was 46 years old. Half of visitors lived in urban areas and half in rural areas. A Little more than half of them considered themselves very familiar with Livanjski cheese, while the rest of them considered themselves as average or unfamiliar with Livanjski cheese. Eighty six percent of the consumers believed that Livanjski cheese is produced in Livno, while the rest believe that Livanjski cheese could be produced in other regions such as Glamoč, Tomislavgrad or Kupres. More than half of the consumers purchased Livanjski cheese monthly and third of them purchased Livanjski cheese weekly (Figure 1).

The largest number of surveyed consumers purchased their cheese from supermarkets (62 %), while the rest bought it either from local farmers' market or directly on farms. Considering the consumption, 64 % of respondents consumed Livanjski cheese weekly, which was similar to the results obtained by Sarić et al. (2010) who found that 60 % of consumers consumed Livanjski cheese at least once a week. Thirty per cent of respondents consumed the cheese monthly and 6 % of them consumed the cheese rarely (Figure 2).

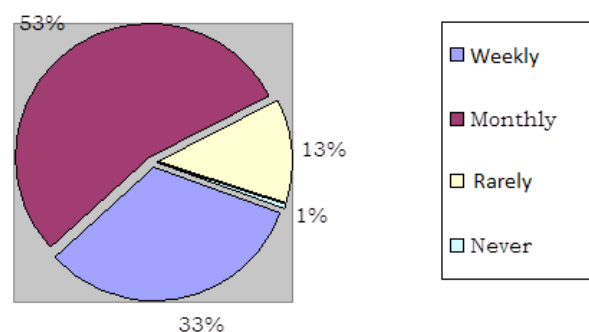


Figure 1. Purchasing frequency of Livanjski cheese

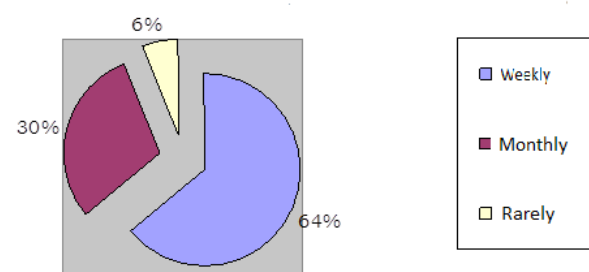


Figure 2. Consumption frequency of Livanjski cheese

Sensory scoring of Livanjski cheese

According to the surveying consumers, the most important attribute for Livanjski cheese was odour (63 %). Twenty six per cent of respondents considered the taste of the cheese the most important attribute, while the rest considered the colour and specificity of the production as the most important attribute (Figure 3). Such results were similar to that obtained by Radman et al. (2004) who found that the odour of dried cheese from the Zagreb region was one of the most important organoleptic parameters, while the cheese price was evaluated as the second most important characteristic. Considering sensory attributes, cheese from farm 1 (F1) was the best scored (16.23, $P < 0.05$) and received the highest scores ($P < 0.05$) for each sensory attribute (Figure 4). According to our observation, specific production of Livanjski cheese on F1 relayed on using a mixture of sheep's and cow's milk (70:30 %) and good ripening conditions (15-18 °C, relative air humidity 80-90% and regular air ventilation). This

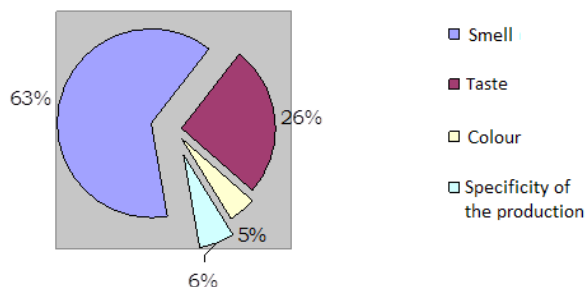
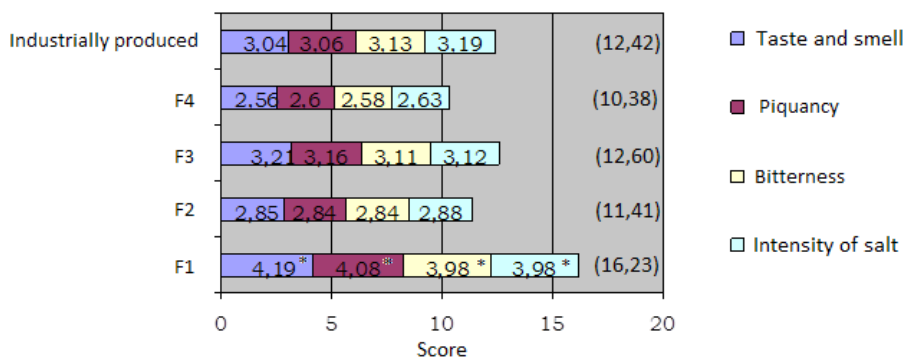


Figure 3. The importance of different attributes of Livanjski cheese according to the respondent's survey



*Values are significantly ($P < 0.05$) different from the same coloured attributes of different columns

Figure 4. The different attributes scoring and total score (in parenthesis) of Livanjski cheese according to respondents' preferences

was not the case for the other farms (F2, F3 and F4) where higher (> 20 °C) temperatures of cheese ripening were evident. Sheep's milk was an important factor for a higher scoring of Livanjski cheese. Sarić et al. (2010) stated that two thirds of tested consumers preferred industrially produced Livanjski cheese. In contrast to that, consumers included in the present study preferred the farm produced Livanjski cheeses, especially those produced from a mixture of sheep's and cow's milk. The observed distinctions might be due to a different profile of respondents included in the studies. In the present study 160 consumers from the wider Livno region were surveyed and were probably more familiar with traditional Livanjski cheese. They could easily purchase Livanjski cheese from local farmers. Sarić et al. (2010) surveyed 60 consumers from central Bosnia and Herzegovina who could mainly purchase industrially produced Livanjski cheese. Such presumptions could be confirmed by a recent investigation in which the local consumer recognised the authenticity of local traditional cheese (Valkaj et al., 2013).

Contrary to the respondents' preference, experts evaluated industrially produced Livanjski cheese with the highest score. Industrially produced Livanjski cheese also received the highest taste score ($P < 0.05$), while the taste scores for farm cheeses produced from a mixture of sheep's and cow's milk was very close to the industrially produced cheese made from cow's milk (Table 1). It could be expected that farm produced cheeses showed more defects due to the low hygienic standards of cheese making and ripening in comparison

to industrially produced cheese. It was recognised by the experts, but not by local consumers who were used to consumption of farm produced Livanjski cheese. Sarić et al. (2010) obtained similar results and found that consumers who were not originally from the wider Livno region evaluated industrially produced Livanjski cheese better

Table 1. Experts' average scores of sensory characteristics of Livanjski cheese

Samples	Judging parameter						Total
	Appearance	Color	Texture	Cut surface	Odour	Taste	
F1 (70:30) ¹	1.88	0.79	1.63	2.25	1.67	8.46 ^{ab}	16.67
F2 (50: 50) ¹	1.96	0.92	1.58	2.29	1.54	8.25 ^{ab}	16.54
F3 (cow's milk)	1.96	0.96	1.67	2.79	1.58	8.00 ^b	16.96
F4 (cow's milk)	1.92	0.96	1.71	2.58	1.54	8.04 ^b	16.75
Industrially produced (cow's milk)	2.00	0.92	1.83	2.88	1.92	9.00 ^a	18.54

¹Mixed milk (sheep's : cow's)^{ab}Values within the same column and not sharing the same superscript letter are significantly different ($P < 0.05$)

Table 2. Composition of 60 day old Livanjski cheese (n=25)

Samples	Fat (g/100 g)	Protein (g/100 g)	Total solids (g/100 g)	FDM (g/100 g)	Salt (g/100 g)	pH	Lactic acid (%)
F1 (70:30) ²	32.00	26.00	64.20	49.84	3.47	5.10	1.51
F2 (50:50) ¹	30.00	28.89	66.45	45.15	3.04	5.30	1.49
F3 (cow's milk)	37.00	26.48	67.92	54.48	2.50	5.28	1.13
F4 (cow's milk)	37.00	26.83	67.31	54.97	2.04	5.29	1.75
Industrially produced (cow's milk)	33.00	26.33	64.94	50.82	2.31	5.40	1.13
Mean value	33.80	26.91	66.16	51.05	2.67	5.27	1.10

FDM = Fat in dry matter

(16,06) in comparison to the farm produced Livanjski cheese (14,38).

Composition of Livanjski cheese in relation to its sensory characteristics

Composition of Livanjski cheese varied depending on the type of milk used in the cheese production (Table 2). Composition of industrially produced Livanjski cheese was within the composition of Livanjski cheeses produced on family farms. According to the present results, Livanjski cheese belonged to the group of hard, full fat cheese, nevertheless from which type of milk it was produced. This was in accordance with the results obtained previously by others (Dozet et al., 1975; Franjić, 1983; Kutle, 1996).

A significantly ($P < 0.05$) higher and negative correlation between total solids and the most important sensory scores of Livanjski cheese (taste and

odour) were obtained by experts (Table 3). Due to the improper ripening conditions on most of the farms (too high temperature - up to 20 °C, and too dry air humidity of ripening chambers - 60-70 %), a significantly higher and negative correlations ($P < 0.05$) between total solids and all sensorial attributes were obtained by consumers (Table 4). Such unfavourable conditions caused an intense evaporation of the moisture during cheese ripening (Kalit, 2009), retarding biochemical activities and the development of the desirable taste, flavour and deteriorated textural characteristics of the cheese, taking into consideration that all the cheeses were of the same ripening age (60 days). The present acids and salts protected cheese against growth of spoilage bacteria and developing the off flavour of the cheese (Stiles, 1996; Havranek et al., 2013), especially when they were produced from raw, low quality milk. Furthermore, a positively higher, but not a significant correlation

Table 3. Correlation coefficients between Livanjski cheese composition and sensory scores obtained by experts

Composition	Sensory score					
	Taste	Odour	Cut surface	Colour	Texture	Appearance
Lactic acid	0.21	-0.17	-0.46	-0.12	0.17	-0.40
pH	-0.81	-0.97*	0.52	0.95*	0.19	0.92
Salt	0.92	0.70	-0.77	-0.87	-0.81	-0.49
Total solids	-0.97*	-0.79	0.85	0.98*	0.50	0.84
Protein	-0.03	-0.68	-0.31	0.34	-0.59	0.62
Fat	-0.79	-0.21	0.89	0.58	0.95	0.17

*P<0.05

Table 4. Correlation coefficients between Livanjski cheese composition and sensory scores obtained by consumers

Composition	Sensory score			
	Taste and odour	Piquancy	Bitterness	Intensity of salt
Lactic acid	-0.27	-0.25	-0.26	-0.22
pH	-0.94	-0.95*	-0.94	-0.96*
Salt	0.79	0.79	0.81	0.82
Total solids	-0.79	-0.80	-0.80	-0.83
Protein	-0.57	-0.57	-0.55	-0.54
Fat	-0.32	-0.32	-0.34	-0.36

*P<0.05

between the salt content and the most important sensory attributes (taste and odour) of the cheese were observed (Table 4). Such results confirmed that salt was the power preserving substance during Livanjski cheese making and ripening, which was in agreement with the postulates of Havranek et al. (2013). Farm produced cheeses with a higher pH (less acid cheese) were significantly ($P<0.05$) lower scored by experts and consumers (Tables 3 and 4), considering attributes like taste and odour. Such results might imply that lactic acid was an important preservative compound in cheese production (Stiles, 1996) characterized by poor hygienic conditions. Industrially produced cheese had the highest pH value (Table 2) and received the highest taste score by experts (Table 1). Proteolysis of cheese with a higher pH value was more intense (Kalit, 2002), resulting in accumulation of undesirable bitter and off flavour products, if the cheese ripened in inappropriate conditions as in the present study. Sensory scores obtained from consumers implied negative correlations between the content of fat and protein in Livanjski cheese, but these correlations were not statistically significant (Table 4).

Conclusion

Livanjski cheese belongs to the group of the most important traditional cheeses of Bosnia and Herzegovina and is consumed weekly by the most of the tested consumers (64 %). Consumers included in the sensory evaluation, preferred Livanjski cheese produced from a mixture of sheep's and cow's milk and ripened under adequate conditions, considering all of the tested sensory attributes. In contrast to that, experts scored industrially produced Livanjski cheese with the highest score. Cheese-makers who produced Livanjski cheese on family farms must avoid too rapid drying of the cheese during ripening since it obviously deteriorated consumers' preferences. Additionally, the salt content of cheese must be increased and fermentation process must be prolonged in order to decrease pH value of the cheese. In this manner cheese could be preserved, poor hygienic conditions during cheese-making could be overcome and the consumers' preference might increase.

Preferencije potrošača i sastav livanjskog sira u odnosu na njegova senzorska svojstva

Sažetak

Cilj ovog rada bio je istražiti preferencije potrošača livanjskog sira ovisno o vrsti mlijeka (kravlje ili miješano ovčje i kravlje mlijeko) i tipu proizvodnje (obiteljska poljoprivredna gospodarstava ili industrija). Također je istražena povezanost između senzorskih karakteristika i sastava livanjskog sira. Za istraživanje su korišteni livanjski sirevi zrelosti 60 dana, od čega su četiri sira proizvedena na obiteljskim poljoprivrednim gospodarstvima, a jedan u industrijskim uvjetima. Tijekom istraživanja provedene su redovite inspekcije (svaka dva tjedna) kako bi se utvrdili uvjeti tijekom zrenja sira (temperatura, relativna vlažnost zraka i ventilacija). U cilju utvrđivanja senzorske ocjene sira u istraživanje je uključeno 160 potrošača i šest stručnjaka. Sir proizveden na gospodarstvu 1 ocijenjen je najboljim ($P < 0,05$) te je dobio najvišu vrijednost za svaku pojedinačnu analiziranu osobinu ($P < 0,05$). Specifičnost proizvodnje livanjskog sira na farmi 1 korištenje je miješanog ovčjeg i kravljeg mlijeka (70:30 %) i dobro kontrolirani uvjeti tijekom zrenja (15-18 °C, relativna vlažnost zraka 80-90 % i redovita ventilacija). Ovčje je mlijeko bilo važan čimbenik za postizanje veće ocjene livanjskog sira. Suprotno od ocjene potrošača, stručni ocjenjivači najboljim su ocijenili industrijski livanjski sir. Utvrđena je signifikantno visoka i negativna korelacija ($P < 0,05$) između suhe tvari sira i ocjene stručnjaka za okus i miris. Štoviše, utvrđena je signifikantna, visoka i negativna korelacija ($P < 0,05$) između suhe tvari sira i svih senzorskih osobina sira dobivenih od potrošača. Suprotno tome, veći udio soli i veća kiselost sira, kao konzervirajući čimbenici, pozitivno su utjecali na senzorske osobine livanjskog sira.

Ključne riječi: ovčje mlijeko, kravlje mlijeko, livanjski sir, preferencije potrošača, senzorska kvaliteta, sastav

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